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TITLE

Through-Flow Volume Limiters

The present invention pertains to a flow rate limiter with a flow body, wherein the flow body is penetrated by at least one channel, through which a fluid can flow, with an inlet port and an outlet port and is provided with at least one gas channel with a gas intake and a gas outlet port for a gas to be mixed with the fluid emerging from the channel.

Furthermore, the present invention pertains to a mount for limiting flow rate with an inlet port and an outlet port for at least one fluid, wherein the inlet port has a larger cross section than the outlet port.

Moreover, the present invention pertains to a process for mixing at least one fluid with at least one gas, among other things, water and air.

A mount of the type mentioned in the introduction has become known, for example, from DE 36 04 267 A1. It pertains to a mount for limiting flow rate, wherein the flow reduction takes place via a movable nozzle piston in connection with a nozzle rod and air is additionally drawn in.

Moreover, the water jet controller and flow limiter for plumbing fittings disclosed in WO 94/20219 contains a water-jet-dispersing means accommodated in a housing, wherein a throttle plate assumes the task of a prethrottling of the water quantity, and the fine adjustment is assumed by a throttle device in a cylindrical perforated plate and is adjustable during the operation.

The drawback of the prior-art mounts is a low mixing rate of fluid and gas and their complicated mechanical design.

The object of the present invention is therefore to create a flow rate limiter in order to achieve a marked flow rate reduction with high gas uptake.

This object is accomplished according to the present invention by a flow rate limiter of the type mentioned in the introduction in that an inlet funnel is connected at the inlet port. The inlet funnel brings about high flow rates of the fluid in the channel; moreover, the fluid is swirled. These high flow rates bring about a vacuum in the area of the outlet port of the channel, so that large quantities of gas are drawn in via the gas channel and are taken up by the swirled fluid. The flow rate of shower water, for example, can thereby be reduced from usually 15 to 19 *L*/min. to 3 to 5 *L*/min., without the showering comfort being diminished, because the volume of the water jet is increased because of the drawing in of air via the gas intake. This makes possible a marked cost reduction in water consumption and in the energy costs for hot water preparation.

In a preferred embodiment, the curvature of the inlet funnel corresponds to a curve $F(x) = C*1/x$. This results in an increased acceleration of the fluid in the channel. This curve shape corresponds, in nature, to known phenomena, in which forces can act optimally (e.g.: tornadoes, coriolis force, etc.).

Increased gas uptake and thus increase in the volume of the fluid are achieved if the at least one channel for the fluid and the at least one gas outlet port open into one plane, for example, into a mixing chamber.

The manufacture of a flow rate limiter according to the present invention is made considerably easier if the at least one channel has a circular cylindrical design and is arranged axially in the flow body.

In commercially available flow rate limiters, the drawing in of gas can be interrupted and fluid can come into the gas channel because of pressure differences in the supply line of the fluid. This effect can be prevented if a nonreturn valve is advantageously arranged in the gas channel.

In another embodiment of the flow rate limiter, it has a recess for receiving magnetic, inorganic or organic materials. According to different studies, magnets have an effect on the deposit of lime in water-supplying lines and fittings.

Furthermore, the object is accomplished in that a flow rate limiter arranged between the inlet port and the outlet port of a mount. This mount can be mounted without much trouble on hoses, pipes, fittings and other elements that are provided for the transport of fluids.

In the above-mentioned mount, the gas intake of the flow rate limiter in the mounted state is connected in alignment with a gas intake channel of the mount, so

that an unhindered drawing in of gas is guaranteed.

In another variant of the present invention, the at least one channel for the fluid and the at least one gas outlet port open into a mixing chamber which is permeable in the direction of flow. This has the advantage that the fluid is mixed with the gas after the acceleration of the fluid in the channel.

If the mixing chamber has a truncated cone-shaped cross section, then a maximum gas uptake of the fluid takes place.

In another embodiment of the present invention, the mixing chamber has rounded shoulders, whose curvature corresponds to a curve $F(x) = C*1/x$. This has the advantage that the swirling of the fluid is further enhanced and the gas enrichment is increased.

In the mounted state, the flow rate limiter inserted into the mount can start to vibrate because of the high flow rate of the fluid. This leads to undesired noise development (whistling, droning, etc.). In order to avoid this and in order to make possible a possibly necessary pressure compensation, the flow rate limiter has at least one grooved section on its outer surface.

Likewise, such a mount can be embodied, in which the mount has at least one grooved section on its inner surface.

Hospitals and hotels naturally have a high water consumption; therefore, the use of mounts, which make possible a reduction of the water consumption, is, for ecological and economic reasons, worth striving for. Since, above all, clean and easy-to-clean surfaces are required in hospitals, the outer surface of the mount has a smooth design in another preferred embodiment of the mount.

In another embodiment of the present invention, at least one means for controlling the flow rate is provided in the mount. In addition, this means may be actuated from outside, for example, by means of an Allen key.

Furthermore, in another preferred variant of the present invention the housing has at least one recess for receiving magnetic, inorganic or organic materials in the area of the outlet port or in the area of the flow rate limiter. The material placed in the recess may be, for example, inorganic material that is used for therapeutic purposes. Thus, semiprecious stones are preferably used for energizing drinking water.

The use of the flow rate limiter for mixing water as fluid and air as gas is one of the preferred applications of the present invention; however, the present invention can likewise be used for the swirling and mixing of the greatest variety of

fluids or gases with a drawn-in gas.

The mount can be used in a process for mixing at least one fluid with at least one gas, wherein the flow rate of the at least one fluid is reduced and its flow rate is increased, and the fluid is swirled and then mixed with the at least one gas. A maximum uptake of gas volume is made possible by means of the swirling of the fluid.

If water as fluid and air as gas are used, this process is suitable for increasing the oxygen content of the water, which under the circumstances was stored under pressure for a long time in, for example, pipes or tanks and thus its quality is to be improved as drinking water.

The present invention is explained below based on some nonlimiting exemplary embodiments, which are shown in the drawings. In these drawings:

Figure 1 schematically shows a mount for a flow rate limiter according to Figure 3 with installed flow rate limiter according to Figure 2 in longitudinal section,

Figure 2 schematically shows a flow rate limiter in longitudinal section and on a larger scale,

Figure 3 schematically shows a mount for a flow rate limiter without inserted flow limiter in longitudinal section,

Figure 4 schematically shows a mount for a flow rate limiter with installed flow rate limiter according to Figure 3 and additional means for reducing the cross section in a channel or outlet port,

Figure 5 schematically shows a mount for a flow rate limiter according to Figure 3 with installed flow rate limiter according to Figure 2 with recesses in the area of the outlet port in longitudinal section,

Figures 6a-d schematically show a view of Figure 5 along the line A-A,

Figures 7-9 schematically show other embodiments of a mount according to the present invention.

The mount AUF shown in Figure 1 for limiting flow rate is used, for example, in showers for the reduction of water consumption.

The core part of the mount AUF is the flow rate limiter DUR shown in Figure 2. It has, in a flow body DUK, an inlet port EIN, which has an inlet funnel ELT, through which the fluid, water in this case, can enter the channel KAN. The curvature of the inlet funnel ELT corresponds to a curve $F(x) = C*1/x$ in a plane that runs through

the longitudinal central line γ. Due to this special shape, the water is set into rotation during the passage through the channel KAN and accelerated in the channel KAN. Because of the high rate of passage of the water, a vacuum, which brings about the drawing in of a gas, for example, air, into the gas channel GKA, is formed in the space under the outlet port AUS. The drawn-in air is mixed with the accelerated, swirled water. Due to the bringing of air into the water, the volume of the water jet is increased and the showering comfort is retained, while the water consumption is reduced from, for example, 15 to 19 *L*/min. to 3 to 5 *L*/min.

Of course, the flow rate limiter DUR shown in Figure 2 can be used without the mount AUF shown in Figure 3. For example, a piece of hose can be fastened by means of hose clamps at each of the two ends on the long side assigned to the inlet port EIN and the outlet port AUS of the flow rate limiter DUR.

The mount AUF, as shown in Figure 3, consists of a housing GEH, which has a threaded section (not shown in the figures) in the area of the inlet port INL and of the outlet port OUT, respectively, which are used, for example, for mounting the mount AUF in a shower hose. The surface OBE of the housing GEH has a smooth design, which makes possible a simple cleaning of the mount AUF, which is a property that is also desirable in terms of sterility, in hospitals, for example.

The housing GEH additionally has a gas intake channel GAS, which, with the flow rate limiter DUR inserted, is connected in alignment with its gas intake GAF (Figure 1). The gas channel GKA is secured with a nonreturn valve RUC; consequently, no water can escape at the gas intake GAF in case of pressure fluctuations or the like.

The outlet port AUS of the flow rate limiter DUR is located with the outlet port GUF of the gas channel GKA in one plane and opens into a mixing chamber MIS. This mixing chamber MIS has a truncated cone-shaped cross section, which guarantees an optimal mixing of the water with the air.

In this embodiment of the present invention, the flow rate limiter DUR is inserted into the housing GEH of the mount AUF without additional fastening means. This has the advantage that the flow rate limiter DUR can be removed, without much trouble, from the mount AUF, for example, for cleaning purposes, or a flow limiter equipped with, for example, a different channel diameter can be inserted as a replacement. Consequently, a mount AUF can be equipped with different flow limiters.

Since the flow rate limiter DUR in the embodiment described here is only inserted into the mount AUF and is not additionally fixed, the flow rate limiter DUR in the

mount AUF may vibrate because of the high passage rates of the water. This vibrating is linked with undesirable noise development. In order to avoid such effects, the outer jacket AMA of the flow body DUK has a grooved section NUT.

In another embodiment of the present invention (not shown), the grooved section is located on the jacket interior IMA of the mount AUF.

Another variant of the present invention is shown in Figure 4. The mixing chamber MIS likewise has curved shoulders SUL, whose shape corresponds to a curve $F(x) = C*1/x$. In addition, means MIT are shown, which control the inflow and outflow of the water. In this case, for example, a pin, which has an enlarged tip (not shown), is inserted into the channel KAN or into the outlet port OUT. As a result, the diameter of the channel or of the outlet port OUT is reduced, and the flow is reduced. The pin tip can be positioned, for example, by rotating the pin in a corresponding threaded section.

The media used are water as fluid and air as drawn-in gas. Of course, the use of any fluids (liquid or gaseous) is conceivable.

The other embodiment of the present invention shown in Figure 5 has a recess AUN in the area of the outlet port OUT. As shown in Figure 6a, this has a ring-shaped design. The recess AUN is used for receiving magnetic materials. Studies have shown that magnetic fields have a positive effect on lime deposits in water-conducting lines and fittings. Therefore, the use of magnets can reduce possible lime deposits in the flow rate limiter DUR and in the mount AUF.

Figures 6b through 6d show other embodiments of the recess AUN. The recess AUN may also be embodied in the form of two or more bores, which are arranged symmetrically about the outlet port OUT.

Furthermore, the recesses AUN may be positioned in the housing GEH or even in the flow rate limiter DUR. In the embodiment shown in Figure 7, two recesses AUN, which are arranged in the area of the flow rate limiter DUR, are located in the housing, while, in the variants shown in Figures 8 and 9, the recesses AUN are embodied in the flow rate limiter DUR. The latter embodiment has the advantage that it is simple to manufacture.

It is understood that the recesses can be arranged in the device in a wide variety of ways. Likewise, combinations of the above-described embodiments are possible. The recess may likewise be embodied, such that the receiving of a plurality of magnets placed next to one another or in one another is made possible.

Also, the use of the recesses is not restricted to the receiving of magnetic

material. The receiving of inorganic or organic material, for example, semiprecious stones, Schüssler salts or Bach flower essences can likewise be provided for therapeutic purposes. Combinations of the different materials are likewise possible.